

Application No. 09/997,417
Amendment dated April 2, 2004
Reply to Office Action of December 5, 2003

PATENT

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (canceled)

Claim 2 (previously presented): A method in accordance with claim 26 wherein the measuring channel and the additional channel are operated at least substantially simultaneously for each object distance.

Claim 3 (canceled)

Claim 4 (previously presented): A method in accordance with claim 26 wherein the received signals of both the measuring channel and of the additional channel are used to determine a distance value serving as the measure for the object distance.

Claim 5 (previously presented): A method in accordance with claim 26 wherein in at least one of the measuring channel and in the additional channel the respective intensity distribution of the received signal on the reception unit is used for determining the distance.

Claim 6 (previously presented): A method in accordance with claim 5 wherein one of the position of a center of the intensity distribution and of a characteristic region of the intensity distribution is used in at least one of the measuring channel and the additional channel for determining the distance.

Claim 7 (previously presented): A method in accordance with claim 27 including providing a separate transmission unit for each of the measuring channel and the additional channel.

Claim 8 (previously presented): A method in accordance with claim 7 including emitting the sensing rays of the measuring channel and of the additional channel in different directions.

Application No. 09/997,417
Amendment dated April 2, 2004
Reply to Office Action of December 5, 2003

PATENT

Claim 9 (previously presented): A method in accordance with claim 8 wherein, when mutually corresponding characteristic regions of the received signals of the measuring channel and of the additional channel are jointly evaluated, an investigation is being made in each case whether they are mutually displaced by an expected amount.

Claim 10 (previously presented): A method in accordance with claim 7 including focusing the sensing rays of the measuring channel and of the additional channel at different distances.

Claim 11 (previously presented): A method in accordance with claim 10 wherein, when mutually corresponding regions of the received signals of the measuring channel and of the additional channel are jointly evaluated, an investigation is being made in each case whether the emitted sensing rays are imaged with different degrees of sharpness.

Claim 12 (previously presented): A method in accordance with claim 27 including focusing the sensing rays of both the measuring channel and the additional channel.

Claims 13 and 14 (canceled)

Claim 15 (previously presented): A method in accordance with claim 26 wherein jointly evaluating comprises deducting the received signal of the additional channel from the received signal of the measuring channel, setting negative difference values resulting from the deduction at zero, and using positive difference signals resulting from deducting for determining the object distance.

Claim 16 (previously presented): A method in accordance with claim 26 including selecting an intensity of the sensing rays such that the received signal is larger in the additional channel than in the measuring channel in a characteristic region which is caused by an interfering object having one of a high reflection and remittance capability in comparison to the sensed object.

Claims 17-25 (canceled)

Application No. 09/997,417
Amendment dated April 2, 2004
Reply to Office Action of December 5, 2003

PATENT

Claim 26 (currently amended): A method for the determination of an object distance between an opto-electronic sensor working according to the principle of triangulation and a sensed object, comprising

providing the sensor with at least one measuring channel between a transmission unit for emitting first electromagnetic sensing rays into the measuring region and a reception unit for detecting sensing rays coming from the measuring region;

providing the sensor with at least one additional channel which has at least one of a further transmission unit for transmitting second electromagnetic sensing rays into the measuring region and a further reception unit;

expanding the second sensing rays and directing the expanded second sensing rays onto the measuring region to form an expanded sensing zone; and

jointly evaluating the received signals of the measuring channel and of the additional channel in order to determine the object distance by forming a difference between the received signals of the measuring channel and of the additional channel.

Claim 27 (previously presented): A method for the determination of an object distance between an opto-electronic sensor working according to the principle of triangulation and a sensed object, comprising

providing the sensor with at least one measuring channel between a transmission unit for emitting first electromagnetic sensing rays into the measuring region and a reception unit for detecting sensing rays coming from the measuring region;

providing the sensor with at least one additional channel which has at least one of a further transmission unit for transmitting second electromagnetic sensing rays into the measuring region and a further reception unit for receiving signals;

evaluating the received signals of at least one of the measuring channel and the additional channel to determine a distance value for the object distance;

determining from the signals received by the further reception unit whether the signals fulfill at least one additional criterion; and

Application No. 09/997,417
Amendment dated April 2, 2004
Reply to Office Action of December 5, 2003

PATENT

using the distance value as the measure of the object distance if the additional criterion is fulfilled.

Claim 28 (previously presented): A method for the determination of an object distance between an opto-electronic sensor working according to the principle of triangulation and a sensed object, comprising

providing the sensor with at least first and second measuring channels and a transmission unit emitting electromagnetic sensing rays into a measuring region, each channel including one of a reception unit and an optical reception system for detecting sensing rays coming from the measuring region; and

arranging the transmission unit between the at least one of the reception unit and the optical reception system, and

jointly evaluating the received signals of the first and second channels to determine the object distance by

respectively determining for the received signals a center of an intensity distribution of the detected sensing rays coming from the measuring region and a distance of the center from a position of the transmission unit, and

using a mean value of the center distances as a measure for the object distance.

Claim 29 (previously presented): A method for the determination of an object distance between an opto-electronic sensor working according to the principle of triangulation and a sensed object, comprising

providing the sensor with at least first and second measuring channels and a transmission unit emitting electromagnetic sensing rays into the measuring region, each channel including one of a reception unit and an optical reception system for detecting sensing rays coming from the measuring region;

arranging the at least one of the reception units and the optical reception system at the same side of the transmission unit; and

jointly evaluating the received signals of the first and second channels to determine the object distance by

Application No. 09/997,417
Amendment dated April 2, 2004
Reply to Office Action of December 5, 2003

PATENT

respectively determining for the received signals a center of an intensity distribution of the detected sensing rays coming from the measuring region and a distance of the center from a position of the transmission unit, and

using a distance between mutually corresponding characteristic regions of the received signals of the first and second channels as a measure for the object distance.

Claim 30 (currently amended): Apparatus for the determination of an object distance between an opto-electronic sensor working according to the principle of triangulation and a sensed object, comprising

at least one measuring channel between a transmission unit for emitting first electromagnetic sensing rays into a measuring region and a reception unit for detecting sensing rays coming from the measuring region;

at least one additional channel which has at least one of a further transmission unit for transmitting second electromagnetic sensing rays into the measuring region and a further reception unit;

a device expanding the second sensing rays and directing the expanded second sensing rays onto the measuring region to form an expanded sensing zone; and

a processor which jointly evaluates the received signals of the measuring channel and of the additional channel in order to determine the object distance by forming a difference between the received signals of the measuring channel and of the additional channel.

Claim 31 (previously presented): A method in accordance with claim 27 wherein the measuring channel and the additional channel are operated at least substantially simultaneously for each object distance.

Claim 32 (previously presented): A method in accordance with claim 27 wherein the received signals of both the measuring channel and of the additional channel are used to determine a distance value serving as the measure for the object distance.

Application No. 09/997,417
Amendment dated April 2, 2004
Reply to Office Action of December 5, 2003

PATENT

Claim 33 (previously presented): A method in accordance with claim 27 wherein in at least one of the measuring channel and in the additional channel the respective intensity distribution of the received signal on the reception unit is used for determining the distance.

Claim 34 (previously presented): A method in accordance with claim 26 wherein expanding comprises expanding the second sensing rays in at least one of an unfocused, scattered, expanded and diffused manner.

Claim 35 (previously presented): A method according to claim 26 wherein the sensing zone covers at least a substantial part of a half-space of the sensor on the sensed object side.

Claim 36 (previously presented): Apparatus for the determination of an object distance between an opto-electronic sensor working according to the principle of triangulation and a sensed object, comprising

- at least one measuring channel between a transmission unit for emitting first electromagnetic sensing rays into the measuring region and a reception unit for detecting sensing rays coming from the measuring region;

- at least one additional channel which has at least one of a further transmission unit for transmitting second electromagnetic sensing rays into the measuring region and a further reception unit for receiving signals;

- a device evaluating the received signals of at least one of the measuring channel and the additional channel to determine a distance value for the object distance;

- a further device determining from the signals received by the further reception unit whether the signals fulfill at least one additional criterion; and

- a processor for using the distance value as the measure of the object distance if the additional criterion is fulfilled.